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"Locating a new Family Activity Centre – a Recreational Development application of GIS"

Manoj Kumar Gaur BSc (Dungar College, India) MSc (Univ. of Glasgow, UK)
Jane Drummond MEng (Univ. of New Brunswick, Canada) PhD (Univ. of Newcastle, UK)
Geomatics Group, Dept. Geographic & Earth Sciences, **University of Glasgow**, G12 8QQ, UK

1.   Background

Loch Lomond and The Trossachs were established as a national park in 2001. Loch Lomond, UK's second largest lake, is situated within 50 km of Glasgow (a major UK city) and has long been an important recreational centre for water sports, hill and forest walking, mountain biking, etc. A long distance path crosses the area (The West Highland Way), taking walkers, in five days, from Glasgow to Glen Nevis (the location of the UK's highest mountain). The lake's cultural and ecological significance has long been recognized. As one of Europe's deepest lakes [Hydromod, 2003; www.hydromod.de/Eurolakes/] it is an important natural freshwater habitat; our university also has an internationally recognized field study centre on the lake's shores [SCENE, 2009; http://www.gla.ac.uk/scene/].

Our university offers four one-year Geomatics MSc programmes which attract UK and international students. Coursework, September to April, precedes the students' six-month research project. As part of their coursework, those students with little background in GIS must find a suitable location for a "**Family Activity Centre**" on the lake, using GIS. Students must submit an individual report on their methods used. Many illustrate their report with their own photos - so the task reviews and explores GIS skills, and encourages visits to an important location near our city!

2.   Requirements

The new "**Family Activity Centre**" must provide: instruction in diving where the water is not too deep and the lake bed is silt free; instruction in sailing and canoeing in water not too crowded by motorised boats; and, footpath access. Accommodation is **not** provided but families can stay in nearby hotels or campsites; daytime meals will be at nearby picnic sites or restaurants.

3.   Sources

Students are provided with data sets (see TABLE I) which can be imported into ArcGIS, but must find more (eg hotels, diving tuition regulations). They can also access digital topographic data sets from the national mapping organization's geospatial database through the Digimap service [edina.ac.uk/digimap] and satellite images through the Landmap service [www.landmap.ac.uk]. A converter for postcode to map coordinates was available [www.nearby.org.uk] for hotels and restaurants. With the data set 'LOMBOATS' (see TABLE II for a fragment of this data set), some students calculated the number of motorboats (eg '*totmot*') in a lake area and then motorboat density (eg '*motdens*').

TABLE I   Data sets provided for the exercise

1. Water depths as X,Y,Depth at sample locations (depths.txt; ASCII)
2. Substrate as X,Y,Sediment Grain Size at sample locations (substrate.txt; ASCII)
3. Terrain model as X,Y and elevation at sample locations (dtm.txt; ASCII)
4. Loch Lomond shoreline and islands feature class (Lomcoast; polygon shapefile)
5. Recreational Boat-use feature class (Lomboats; polygon shapefile)
6. Visitor Centres feature class (Viscents; point shapefile)
7. Car Parks feature class (Carparks; point shapefile)
8. West Highland Way feature class   (Lomwhwy; polyline shapefile)
9. Scannings of the four 1:50000 scale topographic maps covering Loch Lomond from for 'on-screen' digitizing roads, footpaths, etc. (TIF files with the accompanying world or .TFW files), provided by the national mapping organistion.

Every student finds his or her own solution, but a typical flow-line is provided in Table III. Variations arise as students discover different rules regarding optimum depths for diving tuition (2-20m is typical), the danger of silt (very small substrate particle size is hazardous) on the lake bed, etc. Several GIS analytical procedures are used, as shown in TABLE III. Essentially an overlay is carried out of a) the interpolated data sets (eg Fig. 1a) reclassified (eg Fig 1b,c) according to appropriate rules (eg i. sediment size less than 0.05mm or ii. depth between 2 - 20m is suitable for learning to dive) as suitable for a recreational activity, and b) the Distance Maps (eg
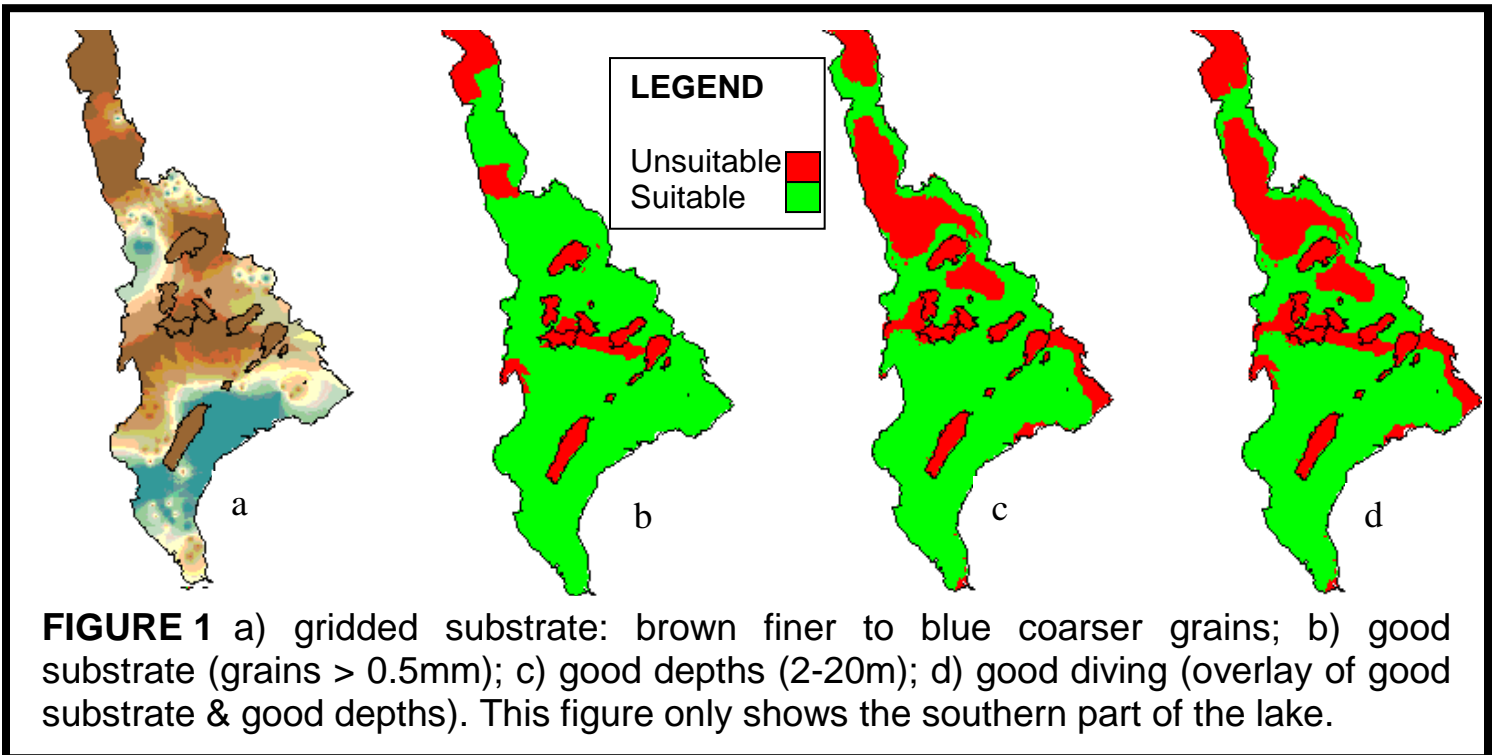
Fig. 2c) of feature datasets (footpaths, hotels, picnic sites, etc.) reclassified as suitable or unsuitable (eg Fig. 2d showing a 0.5km buffer) for the Family Activity Centre location.

4. Outcome

The outcome in terms of the most suitable location for the proposed Family Activity Centre is shown in FIGURE 3. The approach presented in this paper is Figure 3a. An alternative approach (Figure 3b) developed by many students is to maintain the feature classes in vector form, to produce vector buffers around important features such as car parks, hotels, footpaths, etc., and then search interactively for suitable sites This represents a faster but riskier solution!

TABLE II. LOMBOATS attribute table (part), average Saturday summer boat usage.

Attributes of weekendboating

AREA_NAME	WINDSURF	CANOE	YACHT	DINGHY	ROWING	FISHING	CRUISER	HIGH_SP	SPEEDBT	JETSKI	BISC	PLDAY	TOURBT	FERRYBT	totmot	motdens	areadim
12	1	3	1	1	1	12	11	11	67	23	16	17	0	6	151	80.00000	1809125
11	0	4	3	0	1	22	19	14	59	8	5	7	26	5	143	50.00000	2946582
10	1	0	1	0	0	29	21	12	40	2	3	6	34	0	118	20.00000	6722953
9	1	5	2	0	0	32	16	7	24	2	2	1	1	1	54	10.00000	5371382
8	2	2	7	1	1	31	16	15	54	12	28	1	1	1	128	50.00000	2491056
7	0	4	13	2	1	29	21	16	45	9	7	9	0	3	110	30.00000	4083613
6	20	65	78	16	4	38	16	23	87	29	53	17	9	0	234	200.00000	1041457
isl	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.00000	0

FIGURE 1 a) gridded substrate: brown finer to blue coarser grains; b) good substrate (grains > 0.5mm); c) good depths (2-20m); d) good diving (overlay of good substrate & good depths). This figure only shows the southern part of the lake.
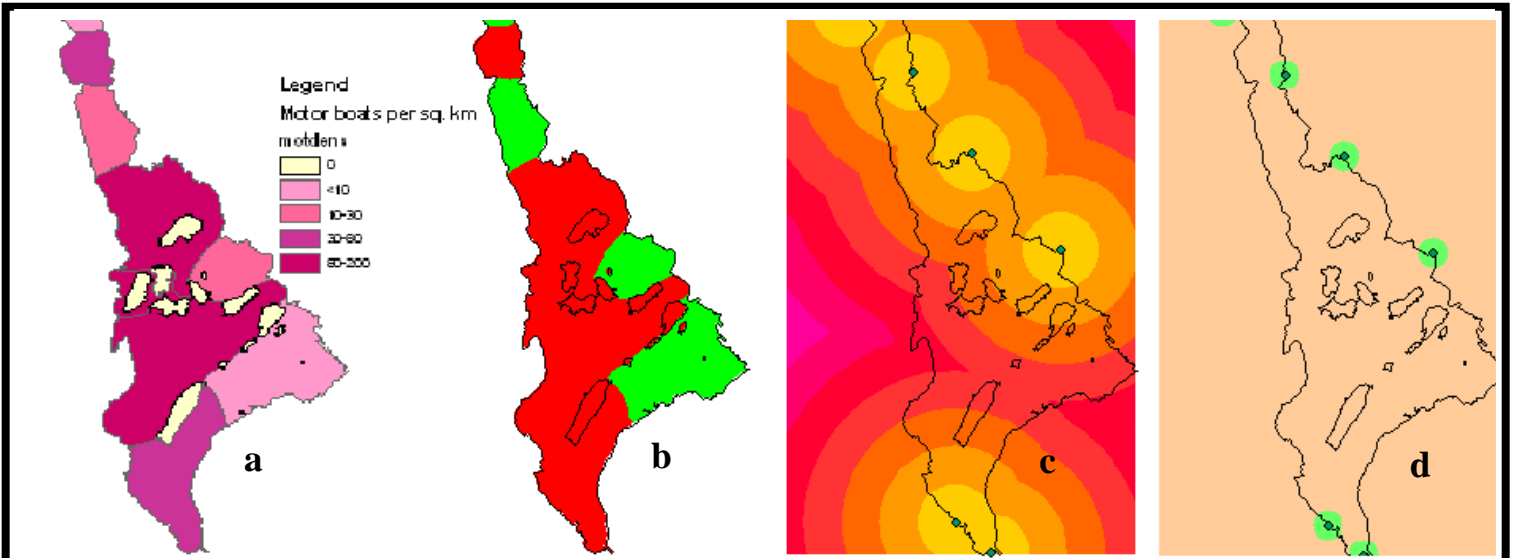
FIGURE 2 a) Motorised boats/km^2 ; b) Fig 2a rasterised and re-classified to give good locations for sailing tuition (<30 motorised boats/km^2) or 'goodsailing'; c) Distance Map of picnic sites; d) Fig 2c re-classified to give 'goodpicnics' – that is areas (green) within 500m of a designated picnic/barbecue site, showing southern part of the lake only.
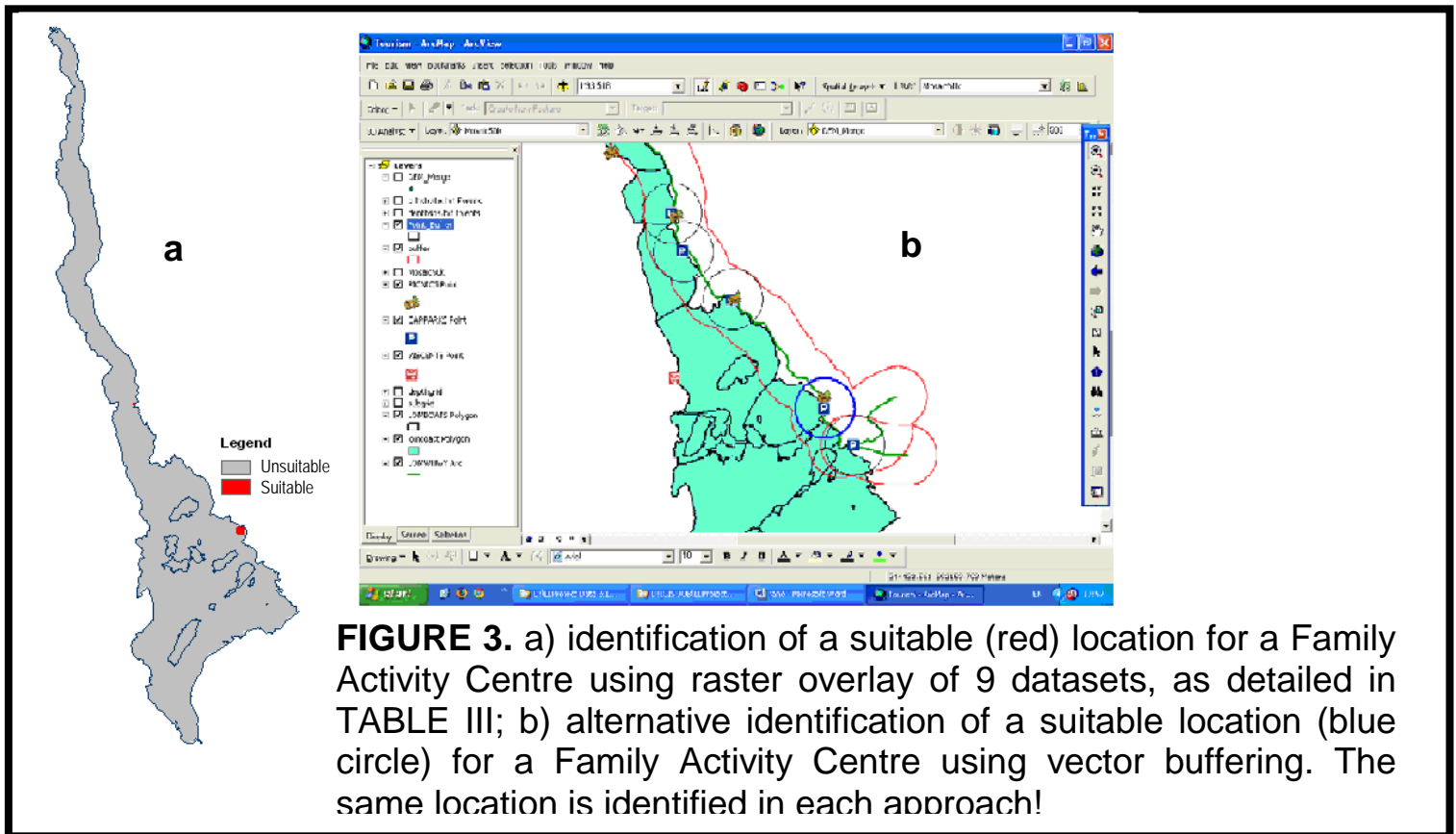

FIGURE 3. a) identification of a suitable (red) location for a Family Activity Centre using raster overlay of 9 datasets, as detailed in TABLE III; b) alternative identification of a suitable location (blue circle) for a Family Activity Centre using vector buffering. The same location is identified in each approach!

5.   Conclusions

It happens that the site identified is indeed popular with learner boatsmen and divers – thus confirming the processing model. For the students, much experience is acquired of GIS processing; also students are learning more about the Loch Lomond and Trossachs National Park!

TABLE III GIS Data Processing to determine locations for a Family Activity Centre

substrate.txt; depths.txt	lomboats	viscents (not used); picnics; carparks	lomhywy	Newly digitized classes: hotels;camps; restaurants
interpolate .txt files to grids (1)	create field *motdens*(motor boats/sq km)	create 2 Distance Maps	edit in extra footpaths	create 3 Distance Maps
mask using **lomcoast** (2)	Rasterise on basis of *motdens*	classify giving **goodpicnics goodcarparks**	create 1 Distance Map	classify giving **goodhotels goodcamps..**
classify giving **goodsubstrate gooddepths**	classify giving **goodsailing**	overlay: **goodpicnics goodcarparks**	classify giving **goodwalks**	overlay: **goodhotels goodcamps..**
overlay: **goodsubstrate gooddepths**				
gooddiving location	**goodsailing** location	**good-infrastructur1** location	**goodwalks** location	**good-infrastructur2** location

overlay all **'good'** data sets

Suitable locations: FAMILY ACTIVITY CENTRE

Legend

Data set

Process